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Mean-blood-pressure Meter

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Arterial blood pressure is one of the most useful variables that can be monitored in the anesthetized patient.1 Arterial cannulation is valuable in assessing instantaneous blood pressure and for managing metabolic and respiratory derangements.2 Systems commonly used today consist of an intra-arterial cannula, pressure transducer, electronic pressure processor, and oscilloscope. Some systems include meter readouts for systolic, diastolic and mean pressure, although the display is usually not visible in more than one location. Large numerical digital displays of many physiologic variables are available but costly.

When cardiopulmonary bypass is employed during operation, knowledge of mean arterial blood pressure is needed by the pump-oxygenator technician. It is difficult to record non-pulsatile pressure from the large-screen arterial pressure waveform.

Therefore, I have designed and constructed a simple electronic instrument allowing remote monitoring of mean arterial blood pressure. The device is designed to connect to the analog waveform output of a Hewlett-Packard 7809 pressure processor or any other similar instrument with sensitivity 1 volt/100 torr.

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The blood-pressure meter consists of a 16 × 9.5 × 5 cm Bakelite box with a meter on the front panel (fig. 1). One hundred- or 200-torr full scale is selected by a front panel switch. Mean blood pressure is continuously displayed, or fluctuations can be observed by depressing the “instantaneous” button on the front panel. This button also serves for rapid calibration.

Diodes D1 through D5 protect meter M1 from overvoltage (fig. 2). Resister R1 and capacitor C1 determine the 1.6-second time constant for low pass filtering of the input to obtain mean input voltage. Depressing front panel switch SW2 disconnects C1 and eliminates input filtering. With switch SW1 in the “100-torr full-scale” position, the series combination of R1, R2, VR1 and the internal meter
Fig. 2. Schematic diagram of the mean-blood-pressure meter.

Resistance (approximately 1.5 K ohms for the Radio Shack meter #22-015 employed) allows 50 μA to flow through meter M1, causing it to read full-scale with 1 volt D.C. applied to the input. When SW1 is in the “200-torr full-scale” position, M1 is shunted by R3, which has been selected to cause half the previous current to flow through M1 with the same input voltage. The full-scale reading of 2 volts (or 200 torr) is the standard electrical calibration voltage used in the Hewlett-Packard pressure monitoring system. The mean-blood-pressure meter is calibrated by adjusting VR1 so that a 200-torr meter reading is obtained when the 2-volt calibration signal is applied. The “instantaneous” button may be depressed for more rapid adjustment.

Input impedance of the instrument is 20,000 ohms for D.C. and 3160 ohms above 0.1 hertz. Sensitivity adjustment requires a screwdriver and rarely needs changing, even when changing the pressure processor. Linearity of the instrument is determined by the linearity of the meter, typically less than 3 per cent. The device requires no power, and obtains its internal electrical ground from the pressure processor; the cover is nonconductive. The total cost of the instrument is less than 30 dollars.

The meter described above has been in routine use for patients on cardiopulmonary bypass since January 1975, with no malfunction. It is an easily built, inexpensive and useful instrument for remote blood-pressure monitoring in the operating room.

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